
Chapter 4

Infiltration and Inflow Policies

The RWSP infiltration and inflow (I/I) policies provide direction to King County on working with the component agencies to reduce the amount of I/I that flows into local systems in order to reduce the impact of I/I on the county's regional wastewater system. The policies call for conducting I/I pilot rehabilitation programs, developing conveyance design standards, and performing other actions to meet RWSP I/I reduction goals. The policies also direct the county to consider an I/I surcharge in order to ensure compliance with I/I reduction measures.

This chapter provides an overview of implementation of the RWSP I/I policies from 2004 through 2006. In accordance with the RWSP reporting policies, this chapter includes a summary of the activities carried out in 2006 related to implementation of the *Executive's Recommended I/I Control Program* that was approved by the King County Council in May 2006. The chapter concludes with summary information on amendments to the I/I policies adopted by the King County Council from 2004 through 2006.

The complete text of all the I/I policies, including information on policy amendments and a summary of how each policy was implemented from 2004 through 2006, is provided in Appendix C.

4.1 Implementation of I/I Policies from 2004 through 2006

I/I is clean stormwater and groundwater that enter the sewer system through cracked pipes, leaky manholes, or improperly connected storm drains, down spouts, and sump pumps. Most inflow comes from stormwater, and most infiltration comes from groundwater (see Figure 4-1).

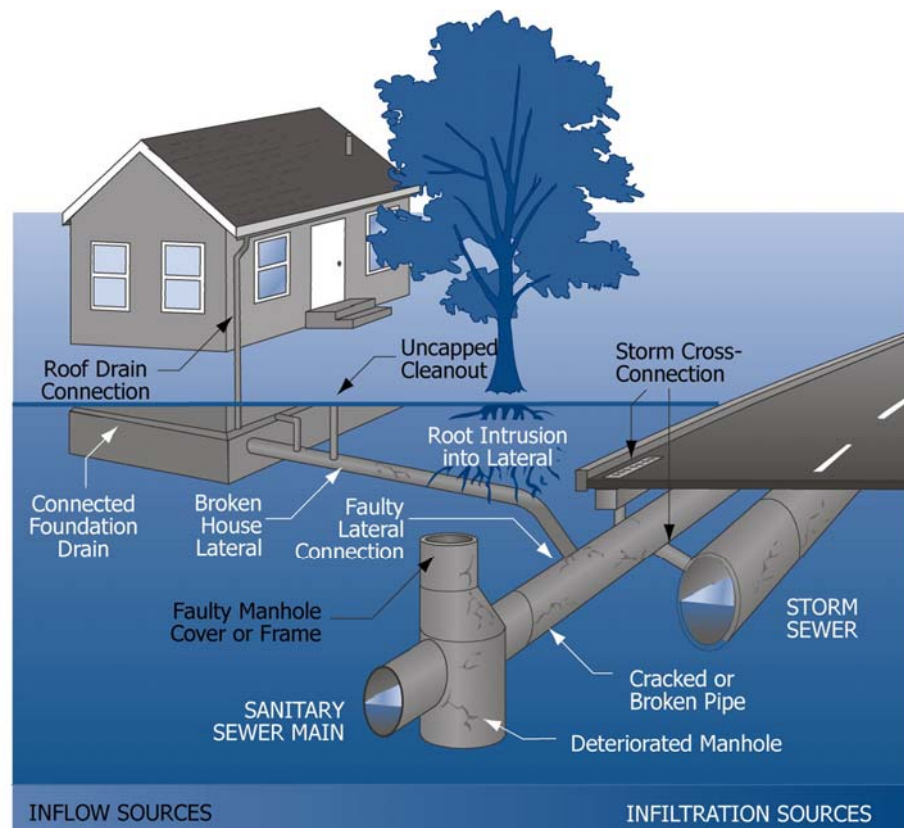


Figure 4-1. Sources of Infiltration and Inflow

I/I affects the size of King County's regional conveyance and treatment systems and, ultimately, the rate that businesses and residents pay to operate and maintain them. About 75 percent of the region's peak flows in the separated conveyance system comes from I/I.¹ Flow volumes can quadruple during rain events when the conveyance system must handle base flow plus I/I (see Figure 4-2). Based on flow monitoring data, it is estimated that 95 percent of the I/I that enters the regional system originates in privately owned side sewers and in component agency systems.

¹ *Regional Wastewater Services Plan, Executive's Preferred Plan*, April 1998, page 14.

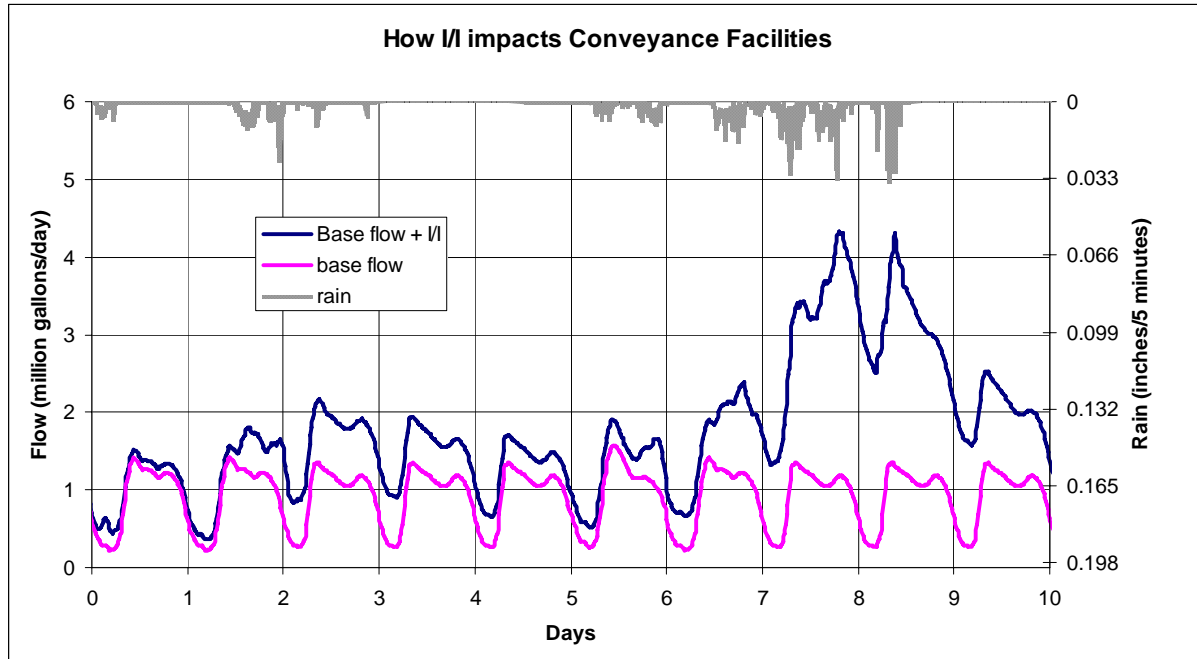


Figure 4-2. Typical Hydrograph Showing Impacts of I/I on Wastewater Flows

This section provides an overview of the major activities carried out in 2004–2006 in accordance with the I/I policies.

4.1.1 Six-Year Comprehensive I/I Study

RWSP I/I Policy (I/IP)-2 calls for conducting I/I pilot rehabilitation projects, developing conveyance design standards, and submitting a report to the King County Council on the options and associated cost of removing I/I. The work associated with the six-year study to complete these tasks was carried out in accordance with RWSP I/IP-2 and documented in the *2004 RWSP Update* and the 2004 and 2005 RWSP annual reports.² Brief descriptions of the four key elements of the study are as follows:

- Region-wide flow monitoring
Approximately 800 flow meters were installed throughout the region in areas with separated sewers during the winter months of 2000–2001 and 2001–2002. Flow monitors were placed in component agency systems and provided the needed information to define the current levels of I/I for each agency tributary to the county's regional wastewater system.

² The documents detailing the results of the six-year comprehensive study and the *Executive's Recommended I/I Control Program* are available on the Web at <http://dnr.metrokc.gov/wtd/i-i/library.htm#reports>

- Ten pilot I/I reduction projects

Ten pilot projects were completed in 2004 and included a mix of projects on public and private property in 12 component agency jurisdictions. Technologies tested by the pilot projects included lining pipes using various cured-in-place materials, replacing pipes by pipe bursting or open-cut methods, replacing manholes, rehabilitating manholes by using chemical grouting or epoxy injection and by adjusting frames and covers, and installing cleanouts. Rehabilitation technologies reduced I/I in eight of the ten pilot projects. An important lesson learned during these projects is that I/I control would not have been possible without the support of the component agencies and private property owners.

The pilot projects demonstrated that I/I can be effectively reduced, depending on the location and method of rehabilitation. However, none of the pilot projects, either individually or collectively, was of sufficient scale to test the cost-effectiveness of I/I reduction in relation to constructing larger conveyance system improvements.³

- A regional needs assessment

The purpose of the Regional Needs Assessment (RNA) was to identify needed conveyance system improvement (CSI) projects, the year they would be needed, and their estimated costs to serve as a baseline for conducting benefit-cost analyses of potential I/I reduction projects. The RNA was completed in March 2005.

- A benefit-cost analysis

To make the most effective use of county resources, King County's Wastewater Treatment Division (WTD), with input from the component agencies, evaluated whether it would be cost effective to eliminate or delay CSI projects identified in the RNA by reducing the amount of I/I in the conveyance system. The benefit-cost analysis compared the estimated costs of constructing CSI projects with the estimated costs of I/I reduction projects. Nine potential cost-effective I/I reduction projects were identified in the *Benefit-Cost Analysis Report*, which was completed in November 2005.

4.1.2 Executive's Recommended I/I Control Program

The results of the six-year comprehensive I/I study were used to prepare the *Executive's Recommended Regional Infiltration and Inflow Control Program*. The program report was completed in December 2005 and transmitted to the King County Council for review and approval by the Regional Water Quality Committee and the King County Council. The council approved the recommended I/I control program in May 2006 via adoption of Motion 12292.

The recommendations in the approved program represent the consensus reached by the county and component agencies throughout the six-year program development process. The recommendations reflect the need to reduce I/I by cost-effectively removing enough I/I from the collection system to delay, reduce, or eliminate some otherwise needed CSI project. The recommendations also reflect the need to maintain I/I reductions long-term to prevent future increases in I/I throughout the regional system. Long-term I/I control includes policy,

³ I/I reduction is considered cost-effective when the total estimated CSI project savings is greater than the total estimated cost of I/I reduction.

administrative, financial, and technical measures that promote an ongoing program of review, maintenance, and repair of the collection and conveyance system.

A key component of the recommended I/I control program is the selection and implementation of two or three “initial” I/I reduction projects from the list of the nine cost-effective projects identified in the *Benefit-Cost Analysis Report* in order to test planning assumptions on a larger scale and gain more information about costs. The recommended program calls for the initial projects to be funded through King County wastewater revenue that is dedicated to funding CSI projects in the regional conveyance system.

I/I Recommended Program Highlights

King County and the local agencies will select, implement, and evaluate two or three “initial” I/I reduction projects to test the effectiveness of I/I reduction on a larger scale than the pilot projects.

After completion of the initial projects, recommendations will be made to the King County Council regarding long-term I/I reduction and control, including applicable changes to policy or code.

The recommended program also includes applying the draft standards, guidelines, procedures, and policies that were developed by King County and the Metropolitan Water Pollution Abatement Advisory Committee (MWPAAC) during the I/I study to the initial I/I reduction projects.⁴ In addition, the recommended program includes the recommendation to not implement a surcharge as contemplated in the RWSP I/I policies; the county and component agencies found that implementing such a surcharge would be costly to administer, would pose difficulties in verifying violations, and would not result in sufficient revenue to be used to reduce I/I. There was agreement among the county and MWPAAC to complete and evaluate the initial projects before proposing any amendments to the RWSP I/I policies.

Details on the *Executive’s Recommended I/I Control Program* were provided in the 2005 RWSP Annual Report. The complete report on the recommended I/I control program is available on the Web at <http://dnr.metrokc.gov/wtd/i-i/library/ExecRec/report.htm>

4.2 Implementation of the Executive’s Recommended Regional I/I Control Program in 2006

The RWSP reporting policies require the RWSP comprehensive review report to include all elements of the RWSP annual report, replacing the annual report for the year that the comprehensive review report is produced. This section meets the 2006 RWSP annual report requirements for the county’s regional I/I control program.

I/I control program efforts in 2006 focused on starting implementation of the *Executive’s Recommended I/I Control Program*. As noted earlier in this chapter, details on the recommended

⁴ MWPAAC advises the King County Council and Executive on matters related to reducing water pollution. It was created by state law (RCW 35.58.210) and consists of representatives from cities and local sewer utilities that operate sewer systems in King County.

program were documented in the *RWSP 2005 Annual Report*. This section provides information on implementation of the recommended program in 2006 and early 2007.

4.2.1 Development and Application of Selection Criteria

In spring 2006, WTD worked with MWPAAC's Engineering and Planning (E&P) Subcommittee to start implementing the recommended I/I control program. The first step in the process was to review the details of the nine cost-effective projects identified in the *Benefit-Cost Analysis Report* and develop and apply criteria to select the two to three projects to be implemented as initial projects. Table 4-1 provides details on the nine projects.

Throughout the summer of 2006, WTD staff and MWPAAC's E&P Subcommittee developed and applied a set of primary and secondary selection criteria to the nine projects. As a result of these efforts, the E&P Subcommittee recommended that four projects undergo further evaluation through sewer system evaluation survey (SSES) work and predesign.⁵ Based on the results of this work, at the end of predesign, WTD will work with MWPAAC to select the two to three most feasible projects for design and construction.

Table 4-1. Cost-Effective I/I Reduction Projects Identified in the *Benefit-Cost Analysis Report*, November 2005

Project (Facility)	I/I Available (mgd)	I/I Reduction (mgd)	Benefit: Capital CSI Cost Reduction	Cost: I/I Reduction Project	Benefit- Cost Ratio	No. of Private Properties
South Renton Interceptor (RE*SRENTON.R18-16(9))	7.0	0.81	\$7,270,000	\$2,217,645	3.3	119
ULID 1 Contract 4 (RE*ULID 1-4.S-31(8))	5.5	1.08	\$2,410,000	\$999,123	2.4	101
Auburn 3 New Storage (Auburn3 Twin Tube Storage)	52.8	6.87	\$22,990,000	\$11,362,511	2.0	1,176
Issaquah 2 Trunk (RE*ISSAQ2.R17-40(3))	5.4	1.05	\$5,770,000	\$3,964,850	1.5	395
Bryn Mawr Storage (Bryn Mawr Tube Storage)	16.2	2.04	\$8,510,000	\$6,018,534	1.4	557
Lk Hills Trunk 3rd Barrel Upgrade (WE*LKHILLST.ENTR(3))	10.8	2.20	\$14,438,000	\$11,307,052	1.3	1,086
Eastgate Storage and Trunk (Eastgate Tube Storage)	8.7	3.55	\$16,629,000	\$14,459,862	1.2	1,163
Wilburton PS / Factoria Trunk (RE*FACTOR.RO6-05(7))	10.4	2.39	\$12,058,000	\$10,550,378	1.1	976
Garrison Creek Trunk (RE*ULID 1-5.57(10))	5.7	2.12	\$13,660,000	\$12,013,489	1.1	1,275

⁵ SSES consists of closed circuit TV inspections and other testing methods designed to identify specific types and locations of I/I sources within sewer system components.

Selection Criteria

The primary and secondary criteria that were applied to the nine projects are as follows:

Primary Criteria

- Implementation of the I/I reduction project allows for the use of field-tested I/I rehabilitation technologies
- Implementation of the I/I reduction project has a mid-range projected benefit-cost ratio (to test the ability to reduce I/I cost-effectively)
- There is an adequate level of service in conveyance facilities within the I/I reduction project area to allow time to implement the I/I reduction process without risking public health
- Predesign, design, construction, and post-flow monitoring work for the I/I reduction should be completed as close to the budgeted date for construction of the associated conveyance system project as practicable
- Implementation of the I/I reduction project will not require extraordinary permitting and environmental review processes that could make it difficult to complete project design, construction, and post flow monitoring within three to five years, or within budget
- Implementation of the I/I reduction project is supported by the host local agency
- The I/I reduction projects selected for implementation have a total cost of \$25 million or less (2007–2011 budget projection), unless additional funds are contributed by host local agencies

Secondary Criteria

- All other project details being equal, implementation of the I/I reduction project will directly benefit multiple local agencies
 - Rehabilitation work will be done within more than one local agency system and/or
 - The I/I reduction project will address a capacity need or needs within a conveyance component(s) that conveys flows from multiple local agencies
- All other project details being equal, implementation of the I/I reduction project helps address an identified overflow or public health issue within the local sewerage agency's system

Projects Selected for Further Evaluation

Based on application of the selection criteria, four projects were selected to undergo further evaluation through sewer system evaluation survey (SSES) work and predesign. Upon completion of this work, WTD and MWPAAC will then work together to select the two to three most feasible projects for construction. The four projects selected for SSES work and predesign are as follows:

- **South Renton Interceptor.** This proposed I/I reduction project could eliminate the need for the South Renton Interceptor Upgrade. The I/I reduction project includes side sewer and lateral rehabilitation in one mini-basin in the City of Renton. The estimated cost for the I/I reduction is \$2.2 million and is projected to remove 0.8 million gallons per day (mgd) of I/I from the local agency collection system, which is approximately 15 percent of the total I/I present in this mini-basin.^{6,7}
- **Issaquah 2 Trunk.** This proposed I/I reduction project could eliminate the need for constructing the Issaquah 2 Trunk. The I/I reduction project includes side sewer and lateral rehabilitation in two mini-basins in the City of Issaquah. The estimated cost for the I/I reduction is \$4 million. It is projected to remove 1.05 mgd of I/I from the local agency collection system, which is approximately 19.4 percent of the total I/I present in these mini-basins.
- **Bryn Mawr Storage.** This proposed I/I reduction project could reduce the size of the Bryn Mawr Tube Storage Facility. The I/I reduction project includes side sewer and lateral rehabilitation in two mini-basins in Bryn Mawr. The estimated cost for the I/I reduction is \$6 million and is projected to remove 2.04 mgd of I/I from the local agency collection system, which is approximately 12.6 percent of the total I/I present in these mini-basins.
- **Eastgate Storage and Trunk.** This proposed I/I reduction project could eliminate the need for the Eastgate Tube Storage Facility improvement. The I/I reduction project includes side sewer and lateral rehabilitation in five mini-basins in the City of Bellevue. The estimated cost for the I/I reduction is \$14.5 million. It is projected to remove 3.55 mgd of I/I, which is approximately 40.8 percent of the total I/I present in these mini-basins.

4.2.2 I/I Initial Reduction Projects Schedule

Requests for proposals were issued in early 2007 for the SSES work and a notice to proceed (NTP) on the SSES contract was issued in late March 2007. Requests for proposal for predesign were issued in early 2007. An NTP on the predesign contract was issued in July 2007.

SSES work began in summer 2007; this work is expected to be complete by the end of 2007. The methods being used to conduct the SSES work include:

- **TV Inspection.** Use of closed circuit TV cameras pushed down a sanitary sewer line can record a "movie picture" of the conditions in that section of sewer. This recording can identify breaks, root intrusion, leaking water (especially infiltration from groundwater), and general deteriorating conditions. Camera equipment usually is operated from

⁶ The costs and estimated I/I reduction quantity for the Renton I/I project have been revised from the original estimates shown in Table 4-1, to reflect the elimination of the Soos Creek basin from the project. It was determined that the marginal additional amount of I/I reduction possible from the Soos Creek basin would not be necessary in order to achieve the I/I reduction target for elimination of the South Renton Interceptor CSI project.

⁷ On average, a mini-basin consists of approximately 150 acres and 22,000 feet of pipe.

manholes located in streets or within public rights of way. Occasionally access to easements in backyards or alleys is required to inspect the public sewer in these areas.

- **Smoke Testing.** Smoke testing involves pumping smoke through sanitary sewer pipes from manholes in streets or within public rights of way and observing and documenting where smoke exits. Depending on the specific circumstances, the exiting smoke can indicate the location of a broken pipe, manhole, catch basin, or where roof or foundation drains might be connected to the sewer system, indicating where infiltration or inflow might enter the sanitary sewer system.⁸
- **Dye Testing.** By using fluorescent colored dye, inappropriate connections can be determined. For instance, if a dye is introduced to a catch basin and the dye is then observed in the sanitary sewer downstream from that point, the evidence would indicate that the catch basin is directly connected to the sanitary sewer system. The dyes that are used are biodegradable and safe for the environment and the sewer lines.

King County is working closely with the component agencies hosting the projects to notify affected homeowners, businesses, residents, and the surrounding community about the SSES work. WTD has established a 24-hour project information line for people to call with any questions or concerns.

Predesign is expected to be complete in fall 2008. At the completion of predesign, WTD and MWPAAC will work together to select the two to three most feasible projects for construction. Construction is anticipated to be complete in late 2011. Post-project flow monitoring and analysis will occur after construction is complete and a final report and findings are expected to be issued in the fourth quarter of 2012. It is likely that amendments to the RWSP I/I policies will be proposed after completion and evaluation of the initial I/I reduction projects.

Visit the Regional I/I Control Program's Web site for more information:

<http://dnr.metrokc.gov/wtd/i-i/>

4.3 Amendments to I/I Policies

The King County Council approved amendments to the RWSP I/I policies via adoption of Ordinance 15602 in September 2006. The amendments are as follows:

- Updated I/IP-2 to reflect conditions as of January 2005; previously the direction in I/IP-2 focused on the I/I pilot projects, which were completed in January 2004.
- Changed the date for the county to consider an I/I surcharge from June 30, 2005, to June 30, 2006. As noted earlier in this chapter, the recommended I/I control program that was approved by the King County Council in May 2006 includes the recommendation to not implement a surcharge.

⁸ A catch basin is an inlet to a storm drain system that typically includes a grate or curb inlet and a sump to capture sediment, debris, and associated pollutants.